The biosphere and nutrient cycles

By Encyclopaedia Britannica, adapted by Newsela staff on 02.09.18
Word Count **889**
Level **1040L**

Image 1. Workers collect bird poop, known as guano, on Asia Island in Peru, June 20, 2008. Guano is used to make some of the world's finest organic fertilizers. Animal waste plays an important role in biogeochemical cycles, like the nitrogen and phosphorus cycles. Photo by: AP Photo/Martin Mejia

The biosphere is the life-supporting area of Earth's surface, extending a few miles into the atmosphere to deep under the ocean. The biosphere is a global ecosystem composed of living creatures and nonliving matter. Living creatures harness energy and food from nonliving elements.

Matter cycles through the biosphere, helped along by solar energy. As different elements come together, they combine to form the building blocks of life and fuel for living creatures.

What Are Nutrient Cycles?

All cells are made up primarily of six elements: hydrogen, oxygen, carbon, nitrogen, phosphorus and sulfur. These elements occur in similar fractions in all living things. While the first four are the most significant, additional elements are also important. Calcium creates structures such as shells, skeletons and cell walls, while chlorophyll allows plants to convert solar energy into chemical energy.

Certain elements are found in higher concentrations in living creatures than in the surrounding environment because animals and plants capture these elements to combine them in various ways. Elements move from being part of living matter to non-living materials as they cycle through the biosphere. The biosphere is composed of three parts: the atmosphere, made up of gases; the lithosphere, made up of soil and the crust; and the hydrosphere, including lakes, rivers and oceans.

Some elements are bound up in rocks, unavailable to living creatures. Weathering and erosion eventually release these elements. For most major materials, however, living organisms not only use them, they also help move these elements through the biosphere.

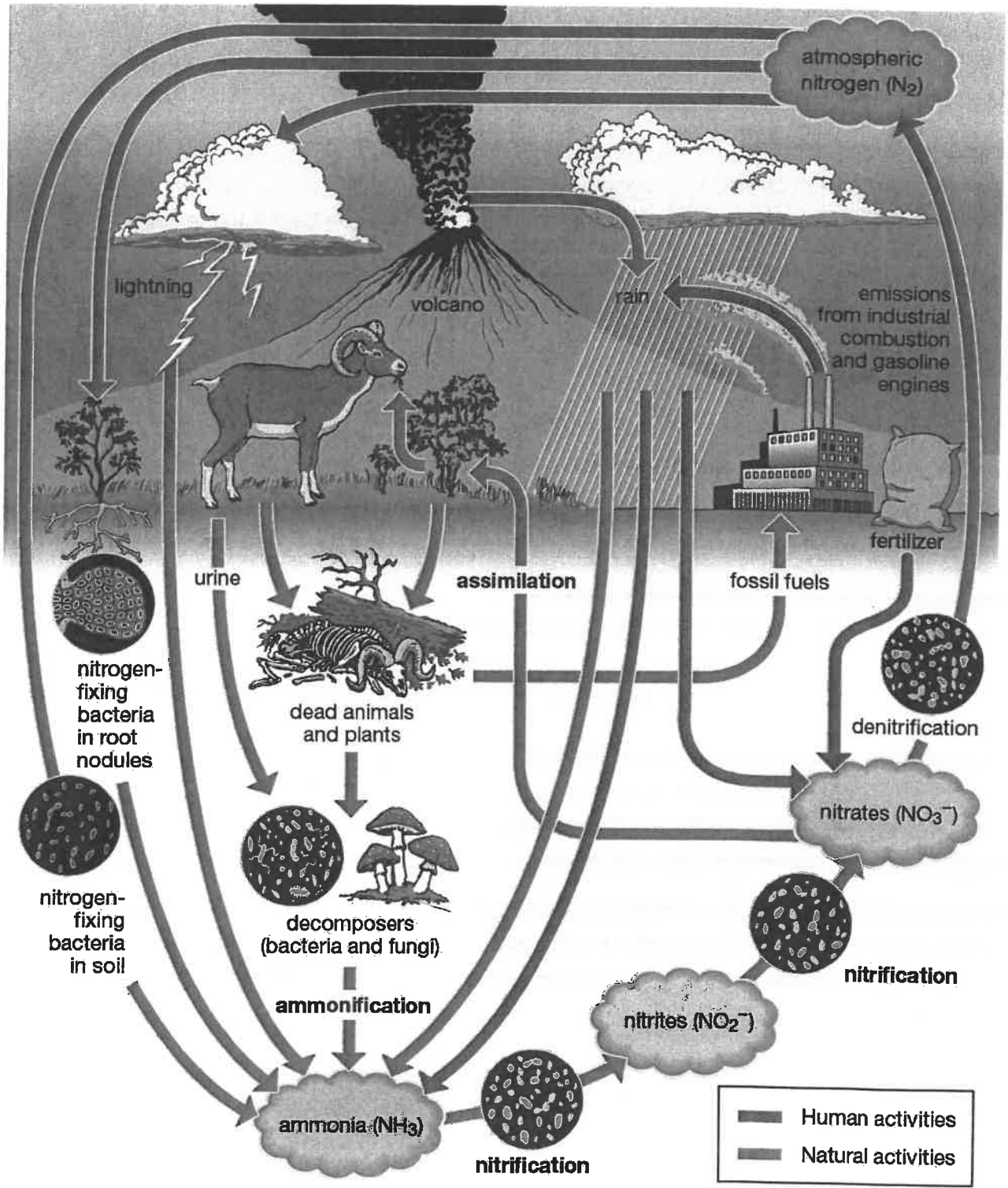
Matter moves through the biosphere differently than energy. Energy cannot be reused, but elements can be recycled. For example, carbon released into the atmosphere could stay there for five years before being taken up by an animal, or it could be used immediately by a nearby plant for photosynthesis.

Carbon Cycle

The carbon cycle moves carbon throughout the biosphere. The carbon in living matter comes from carbon dioxide (CO_2) in the air or dissolved in water. Plants use carbon dioxide during photosynthesis, while animals release carbon dioxide when they breathe out. Bacteria and fungi release carbon dioxide when they consume dead animals and plants.

Carbon sometimes stays in dead animals and plants inside the Earth's crust. This carbon becomes fossil fuels, such as oil, coal or gas. Humans now use fossil fuels in industry and agriculture, releasing vast amounts of CO_2.

Nitrogen Cycle



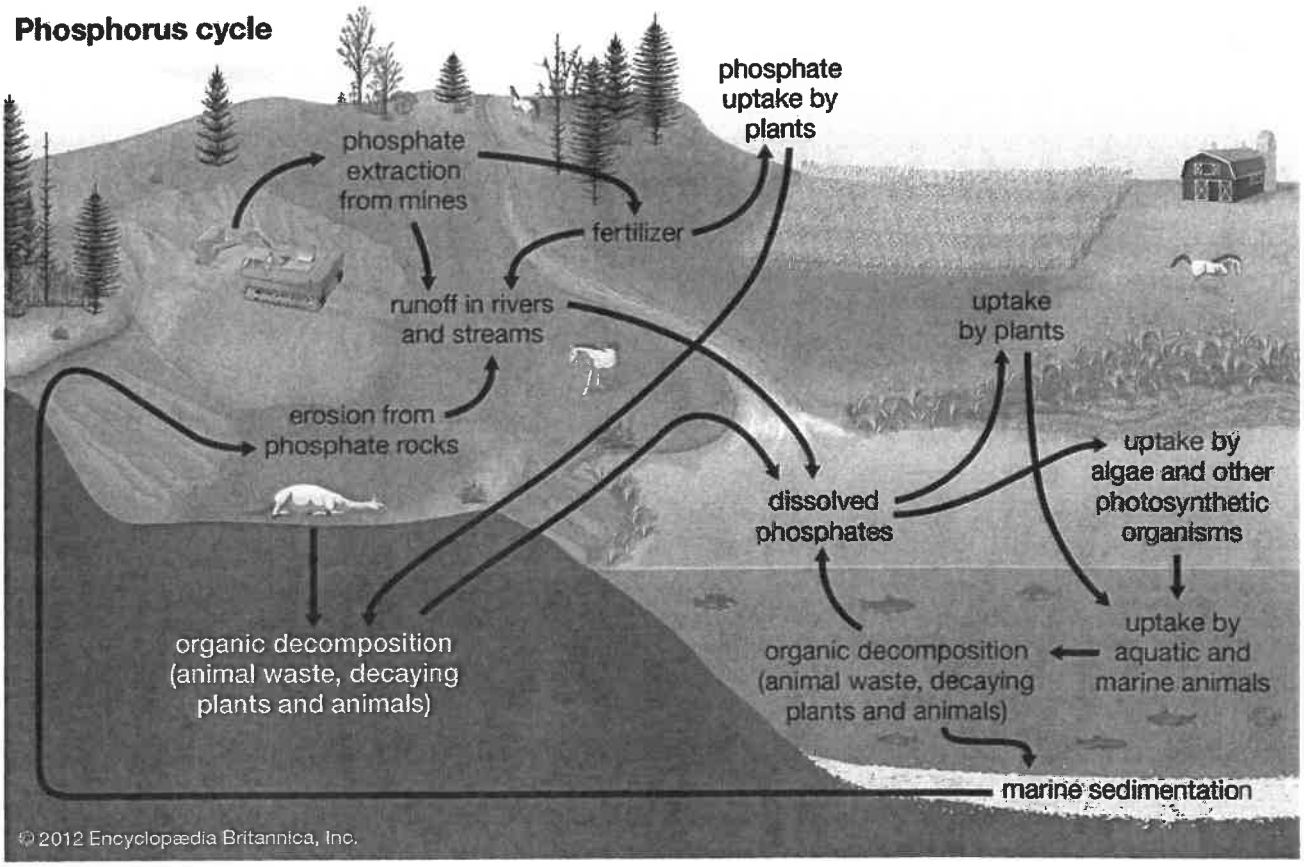
Like carbon, nitrogen also moves through the biosphere, but unlike carbon, most nitrogen occurs in the atmosphere as a gas (N2). However, plants cannot use this form of nitrogen. Nitrogen is pulled from the atmosphere by bacteria, who change it into a form plants can use.

Certain bacteria live near the roots of plants and fungi. The plants offer a shelter for bacteria, and the bacteria draw nitrogen into the soil, making it possible for plants to absorb nitrogen. When bacteria live with fungi, they form a new species called lichen.

After absorbing nitrogen, plants change it into combinations they can use, such as amino acids and proteins. Animals obtain nitrogen by eating plants or other animals. When animals die, microbes take apart dead animals and put nitrogen back into the soil.

Some nitrogen is returned back to the atmosphere by bacteria. Nitrogen is also lost from an ecosystem through erosion, runoff, and leaching from the soil into lakes and streams.

The Phosphorus Cycle



Other major elements, such as phosphorus, iron and calcium, enter the soil through the weathering of bedrock. Phosphorus most often limits plant growth.

Phosphorus moves from land to rivers to the sea before settling at the bottom of the ocean. Phosphorus cycles between the ocean surface and the ocean floor: near the surface, plankton takes up phosphorus and then passes through the food chain. Eventually, phosphorus returns to the ocean floor when living creatures die and fall to the bottom. The ocean floor contains the largest reservoir of phosphorus in the biosphere.

On land, phosphorus moves between living creatures and soil in the form of phosphate. Bacteria in the soil breaks down living matter, releasing phosphate, which is absorbed by plants and released again when they die. Soils differ in the amount of phosphorus they contain. In soils without much phosphorus, almost all of it is found in living creatures. In some tropical forests, living creatures contain so much phosphorus that clearing the forests gets rid of this element. Without phosphorus, plants and crops cannot grow.

Adding phosphorus to soils has affected many natural spaces. Runoff from farms or sewage adds phosphorus to rivers and lakes. The extra phosphorus makes plants grow explosively, sometimes creating a mat of plants that extends over the surface of the water.
More plants decrease the oxygen available, suffocating fish and other animals.

Why Are Nutrient Cycles Important?

Understanding how the biosphere works is very important. When human population levels were low and technology simple, the effect on the biosphere was relatively small. Increasing human population levels and harvesting of Earth's natural resources has transformed this situation, especially in recent decades. Human activities are causing major changes in the biosphere. These changes are removing species that have not even been described but which might have been of central importance to natural areas.